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(54) 5-Aminolevulinic acid producing microorganism, and process for producing it

(57) A microorganism that produces 5-aminolevulinic acid, wherein the microorganism has a 5-aminolevulinic acid dehydratase variant having a reduced inhibitor constant for a 5-aminolevulinic acid dehydratase inhibitor. A microorganism that produces 5-aminolevulinic acid, wherein the microorganism is a photosynthetic bacterium that produces 5-aminolevulinic acid without light irradiation. A process for producing 5-aminolevulinic acid comprising the step of culturing a microorganism that produces 5-aminolevulinic acid in a culture medium under at least one condition selected from the group consisting of (a) less than 1 ppm of dissolved oxygen concentration in the culture medium, (b) from -180 to 50 mV of oxidation-reduction potential in the culture medium, and (c) from 5×10^{-9} to (KrM - 2×10^{-8}) (mol of O_2/mℓ • min • cell) of cellular respiration rate, wherein KrM represents the maximum cellular respiration rate when oxygen is supplied in an excess quantity.

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EUROPEAN SEARCH REPORT

Application Number
EP 95 12 0061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	TANAKA T, WATANABE K, HOTTA Y, LIN D, SASAKI K AND NAGAI S: "Formation of 5-aminolevulinic acid under aerobic dark condition by a mutant of Rhodobacter sphaeroides" BIOTECHNOL LETT., vol. 13, no. 8, 1991, pages 589-594, XP002059141	5,6, 9-14,17, 19,20	C12P13/00 C12N1/20 C12N1/18 //(C12N1/20, C12R1:01,1:19, 1:38), (C12N1/18, C12R1:85)
Y	* the whole document *	11	
Y	PATENT ABSTRACTS OF JAPAN vol. 017, no. 506 (C-1110), 13 September 1993 & JP 05 137587 A (COSMO SOGO KENKYUSHO:KK), 1 June 1993, * abstract *	11	
X	SASAKI K, TANAKA T, NISHIZAWA Y AND HAYASHI M: "Enhanced production of 5 aminolevulinic acid by repeated addition of levulinic acid and supplement of precursors in photoheterotrophic culture of Rhodobacter sphaeroides" JOURNAL OF FERMENTATION AND BIOENGINEERING, vol. 71, no. 6, 1991, pages 403-406, XP002059142 *See abstract and "cultivation methods"*	9-14,17	

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TECHNICAL FIELDS SEARCHED (Int.Cl.6)
C12P
C12N
C12R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 March 1998	Lonnoy, O

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 12 0061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	LUOND RM, WALKER J AND NEIER RW: "Assessment of the active-site requirements of 5-aminolaevulinic acid dehydratase: evaluation of substrate and product analogues as competitive inhibitors" J. ORG. CHEM., vol. 57, 1992, pages 5005-5013, XP002059140 *See Table 1, compound 10* ---	1-4,9-11	
D,A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 471 (C-1245), 2 September 1994 & JP 06 153915 A (COSMO SOGO KENKYUSHO:KK), 3 June 1994, * abstract * -----	1-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

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Application Number
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

SEE SHEET B
(in case of Lack of Unity)

☒ ~~All further search fees have been paid within the fixed time limit.~~ The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 95 12 0061

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-4 (ALL TOTALLY) AND CLAIM 8 (PARTIALLY)

   Microorganism that produces 5-amino-levulinic acid and having a 5-ALA dehydratase with reduced inhibitory constant (Ki).

2. Claims: 5-7 (all totally) and claim 8 (partially)

   A photosynthetic bacterium which produces 5-amino-levulinic acid without light irradiation.

3. Claims: 9-20 (all totally) and claim 8 (partially)

   A process for producing 5-aminolevulinic acid by culturing a microorganism following conditions as defined in claim 9.

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